EFFECT OF STORAGE CONDITIONS ON THE SEED QUALITY OF FRESHLY HARVESTED HIGH MOISTURE UNDRIED RICE SEEDS CV. CO 51

MARTHANDAN. V¹ & JERLIN. R²

¹Research Scholar, Department of Seed Science and Technology, Tamil Nadu Agricultural
University, Coimbatore, Tamil Nadu, India

²Professor, Department of Seed Science and Technology, Agricultural Research
Station, Bhavanisagar, Tamil Nadu, India

ABSTRACT

Storing the freshly harvested high moisture seeds will induce the deterioration faster; it affects the storability of the seed material. The present study was carried out to access the appropriate storage condition to mitigate the seed quality loss of the freshly harvested un-dried seeds. The freshly harvested high moisture rice seeds were transported from Cauveri delta basin and stored under cold and ambient storage condition for 15 days in Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. In order to know the effectiveness of the storage condition, the seeds are drawn at alternative days and the seed quality were studied. The seeds under cold storage performed better than ambient storage condition, in the speed of germination, germination (%), seedling length, dry matter production and vigor index. The seeds stored under cold storage condition recorded higher germination (45) which was 12% higher than seeds stored under ambient storage and it was only (33). Seeds stored under cold storage condition recorded higher vigor index (968) on 15 days after storage and the ambient storage recorded minimum vigor index (670). The moisture content was under decreasing pattern, in cold and ambient storage, the moisture content was (23.8%) to (21%) and (23.0%) and (15.8 %) after 15 days of storage.

KEYWORDS: *OryzasativaL, Un-Dried Seeds, Cold Storage & Ambient Storage*

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INTRODUCTION

Rice (*OryzasativaL.*) comes under the family poaceae, which has the important role in the diet of many people worldwide. Around 90% rice in the world is cultivated and consumed by the population of the Asian countries. In India, it occupies an area of 43.19 Mha with the production of 110.15 MT (Indiastat, 2016-2017). Tamil Nadu alone contributes an area of 1.64 million hectares with the production of 5.11 million tonnes (Indiastat, 2015-2016). Due to the burgeoning growth of the human population in India, the demand for rice will increase. Our country has to produce about 130 MT of rice by 2025 to feed the ever -growing population. India is the second largest producer in the world followed by China. Rice contains a high amount of carbohydrate and proteins and it provides minerals, vitamins, and fibers. In India, rice cultivation is predominant in the humid tropical and sub-tropical climate characterized by high temperature and high relative humidity, resulting in changes in genetic integrity leading to more rapid deterioration of seeds. Due to the post-harvest losses in India amount to 12 to 16 million metric tons of food grains each year, huge wastage of seeds due to lack of storage structures at the farm level. During the rainy days drying the freshly harvested high moisture seeds is not possible. In that situation, the freshly harvested rice seeds are packed with gunny bags and stored. Only after 10 to 15 days the seeds are

transported to the drying yards for drying. Keeping the seeds with high moisture content will cause seed quality losses. The high seed moisture leads to the reduction of seed germination, changes in free fatty acid levels and EC, induction of temperature and decrease in protein contents etc. Resulting the total seed quality loss.

With this background in consideration, the present study was taken up to investigate the effects of storage conditions on the seed quality of freshly harvested rice seed with high moisture content, before going to drying and storage.

MATERIALS AND METHODS

The genetically pure and freshly harvested seeds of rice cv. CO 51 were collected from Cauveri delta basin, Tanjore, Needamangalam and were cleaned and transported to the Department of Seed Science and Technology, TNAU, Coimbatore. The seeds were graded using the recommended sieve size which constituted the research materials for the present investigation. Freshly harvested rice seeds of cv. CO 51 with a high moisture content of 23.80% were packed in moisture pervious container viz., cloth bag and kept for storage under the cold and ambient condition and subsequently drawn at alternative days up to 15 days and the following seed quality parameters were recorded.

Speed of Germination: Four replicates of twenty -five seeds each were used to test the speed of germination of different varieties. The seeds showing radicle protrusion were counted daily from the third day after sowing until the seventh day. From the number of seeds germinated on each day, the speed of germination was calculated using the following formula and the results were expressed in number (Maguire, 1962).

$$\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \dots + \frac{X_n - X_{n-1}}{Y_n}$$

Moisture Content: Five gram of ground seed material was placed in a moisture weighing bottle and kept in a hot air oven maintained at $130 \pm 20^\circ\text{C}$ for 2 h for drying and cooled in a desiccator containing silica gel for 30 min. The weight of seeds along with moisture bottle before and after drying was recorded in gram. The moisture content of the seed was calculated using the following formula and expressed as a percentage (ISTA, 2011).

$$\text{Moisture content} = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

Germination: Four replications with 100 seeds were sown in the towel roll germination paper, and immersed in the water equivalent to 2.5 times the weight of the dry substrate, and were kept inside the germination room ($25 \pm 2^\circ\text{C}$ temperature and $90 \pm 3\%$ RH). The first count was in the seventh day and the final count on the fourteenth day after sowing, and the percentage of normal seedlings was determined and the germination percentage was expressed in percentage (%) (ISTA, 2011).

Seedling Length: The full length of the seedling was measured with the help of the scale and the seedling length was expressed in centimeter (cm).

Dry Matter Production: Randomly selected ten normal seedlings used for seedling measurements were dried under shade for 24 h and then dried in a hot air oven maintained at $85 \pm 1^\circ\text{C}$ for 48 h. It was cooled in a desiccator for 30 min and weighed. The values were expressed as g seedlings⁻¹⁰.

Vigour Index: Vigour index (VI) was computed using the following formula and expressed as whole number.

$$\text{VI} = \text{Germination percentage} \times \text{Seedling length (cm)}$$

RESULTS AND DISCUSSIONS

In the present investigation, storability of the freshly harvested high moisture un-dried rice seeds was studied by subjecting seeds to cold and ambient seed storage for 15 days. All the physiological parameters viz., moisture content, the speed of germination, germination percentage, seedling length, dry matter and vigor index. The significant difference was observed in moisture content of high moisture seeds. Under cold storage condition, moisture content was decreased from 1st day (23.8%) to 15 days after storage (21%). Ambient storage condition recorded minimum moisture content from 1st day (23.0%) and (15.8 %) after 15 days after storage. Among the seed storage conditions, cold storage was the best in maintaining seed germination and seedling vigor. The germination percentage of the seeds under the cold storage was 45% and it was 12% higher than the ambient storage condition after 15 days of storage. The average germination percentage of high moisture rice seeds under cold storage condition recorded higher germination (30) which was 7% higher than seeds stored under ambient storage condition after 15 DAS (Table 2). Even though the moisture content was high in cold storage condition the electrical conductivity was recorded as minimum and it was higher in an ambient storage condition. The high moist seed will induce the rate of respiration and it will induce the enzymatic activity it cause maximum solute leakage in seeds under ambient storage condition. In addition, physiological dormancy decreases with time under dry storage conditions through a process called after-ripening (Holds worth *et al.*, 2008).

In general, some of the crops the freshly harvested seeds need time to ripen fully, it will help the seed to get uniform germination. In such seeds after -ripening period is important for dormancy breaking and to get uniform germination. In arabidopsis dormancy conditioned the germination response to low temperatures, such that prolonged periods of chilling induced dormancy in non-dormant seeds, but stimulated germination in dormant seeds. The alleviation of dormancy through after-ripening was associated with independent of germination date. As a result, long chilling increases germination relative to no chilling in fresh seeds, but reduced germination relative to no chilling in after-ripened seeded. The combined effect of chilling and after-ripening on germination was also genotype dependent (Rafael *et al.*, 2012). The after-ripening duration was found directly affecting the time to fifty percent germination in *Physaria* seeds with less time needed after a longer period of storage, and resulting to more uniform germination (Von *et al.*, 2013).

The speed of germination, is the time taken by quiescent seed to produce radicle to burst out through seed coat or seedling to emerge from the soil surface, is considered as a key factor for assessing the vigor potential of the seed material. The speed of germination differed significantly depends on storage condition, the seeds stored under cold storage condition recorded higher speed of germination (6.53) whereas the ambient storage recorded minimum speed of germination. Seed deterioration is associated with delayed seedling emergence followed by a slower rate of seedling growth and development and decreased germination. Tests based on a speed of germination have long been used as indicators of vigor and it is related to seedling growth rate. It shows the capacity of seed to produce the seedling with minimum time period under favorable conditions. With reference to storage conditions, seeds of sunflower, groundnut, and soybean stored at -20°C recorded maximum speed of germination which was followed by seed stored at -5°C than the seeds stored at ambient condition after ten months of storage (Nithya and Renugadevi, 2012). The reduction in the speed of germination at ambient condition was supported by Arulnandhi and Senanayake (1988) in soybean. He reported that the rate of seedling emergence was drastically reduced for soybean seeds stored with 8.5 percent moisture content. This was supported by Gomathi (2009) in groundnut.

The high moisture seeds stored under cold storage condition were recorded maximum seedling length on 15 days after storage (21.5 cm). It was only 20.3 cm under ambient storage condition. The average seedling length was maximum in cold storage (20.2 cm) condition and the minimum seedling length was recorded in ambient storage (18.8 cm). The cold storage condition recorded higher dry matter production on 15 days after storage ($0.069 \text{ g seedling}^{-10}$) and it was only $0.054 \text{ g/10 seedlings}$ at ambient storage condition. The average dry matter production was maximum in cold storage ($0.073 \text{ g seedling}^{-10}$) and the minimum was recorded in ambient storage ($0.056 \text{ g seedling}^{-10}$) (Table 1). The vigor index differed significantly depends on storage condition, the seeds stored under cold storage condition recorded higher vigor index (968) on 15 days after storage and the ambient storage recorded minimum vigor index (670). The average vigor index was maximum in cold storage (620) and it was recorded only 443 in ambient storage. The dry matter production of the seedling is the ultimate manifestation of physiological vigor (Heydecker, 1973). Seedling vigor is usually characterized by weight of the seedlings after a period of growth (Qualls and Cooper, 1968 and Dasgupta and Austenson, 1973). In the present study, maximum vigor index was observed at cold storage. The lower respiratory activity maintains the higher vigor index of the seedling. Lower dry matter was obtained by seeds stored in ambient condition. This is due to loss of membrane integrity and leakage of food materials which lead to a reduction in the vigor index and dry matter.

CONCLUSIONS

Thus, the present study was concluded that storing the high moisture undried rice seeds under cold storage is found best for high moisture seed storage when compared to the ambient storage condition for initial seed storage before drying and the seed quality was maintained under the cold storage condition.

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Table 1: Effect of Cold and Ambient Storage Conditions on Speed of Germination, Germination (%), Seedling Length (cm) and Drymatter Production (g seedling⁻¹⁰) of Freshly Harvested High Moisture Rice Seeds cv. CO51.

Storage conditions (C)		Days (D)	Speed of Germination			Germination (%)			Seedling Length (cm)			Drymatter Production (g Seedling ⁻¹⁰)		
Cold		1	3.70			16 (16.43)			18.8			0.047		
		3	5.03			21(27.27)			19.6			0.049		
		5	5.20			23(28.66)			19.1			0.051		
		7	5.90			27 (31.31)			19.9			0.054		
		9	6.34			28(31.95)			20.0			0.058		
		10	6.50			33(35.06)			20.6			0.075		
		11	8.09			38(38.06)			21.0			0.122		
		13	8.77			42(40.39)			21.0			0.133		
		15	9.21			45(42.13)			21.5			0.069		
		Mean	6.53			30(33.21)			20.2			0.073		
Ambient		1	3.20			14(21.97)			16.8			0.036		
		3	4.20			17(24.35)			17.4			0.037		
		5	5.00			20(26.56)			18.0			0.038		
		7	5.23			20(26.56)			18.6			0.038		
		9	5.70			22(27.97)			18.9			0.042		
		10	5.40			26(30.65)			19.3			0.054		
		11	6.57			27(31.31)			19.8			0.097		
		13	6.04			30(33.21)			20.1			0.106		
		15	8.03			33(35.06)			20.3			0.054		
		Mean	5.49			23(28.66)			18.8			0.056		
		C	D	CxD	C	D	CxD	C	D	CxD	C	D	CxD	
	SEd	0.071	0.033	0.100	0.369	0.174	0.521	0.238	0.112	0.337	0.001	0.000	0.001	
	CD (P=0.05)	0.202	0.095	0.286	1.057	0.498	1.495	0.683	0.322	0.965	0.002	0.001	0.002	

(Figures in parenthesis indicates transformed arc sine values)

Table2. Effect of Cold and Ambient Storage Conditions on and Vigour Index Seed Moisture Content (%) and Electrical Conductivity (μSm^{-1}) of Freshly Harvested High Moisture Rice Seeds of cv. CO 51

Storage conditions (C)	Days (D)	Vigour index			Moisture content (%)			Electrical conductivity (μSm^{-1})		
Cold	1	301			23.8			180		
	3	412			23.3			172		
	5	439			22.8			163		
	7	537			22.5			158		
	9	560			22.3			145		
	10	680			22.1			140		
	11	798			21.8			129		
	13	882			21.6			121		
	15	968			21.4			113		
	Mean	620			22.4			147		
Ambient	1	235			23.8			180		
	3	296			22.6			176		
	5	360			21.5			172		
	7	372			20.0			160		
	9	416			19.2			151		
	10	502			18.5			142		
	11	535			17.1			136		
	13	603			16.3			130		
	15	670			15.8			124		
	Mean	443			19.4			152		
		C	D	CxD	C	D	CxD	C	D	CxD
SEd		5.542	2.612	7.837	0.260	0.122	0.367	1.584	0.747	2.240
CD (P=0.05)		15.894	7.493	22.478	0.745	0.351	1.054	4.543	2.142	6.425